REMARKS

In response to the objection at paragraph 1 of the Office Action, the specification has been amended at page 9, line 4 by insertion of the missing reference numeral 8 following the words "bus electrodes". Accordingly, reconsideration and withdrawal of this ground of objection are respectfully requested.

Claims 1-6 have been rejected under 35 USC §103(a) as unpatentable over Aoki et al (U.S. Patent No. 5,770,921) in view of Yoshihara et al (U.S. Patent No. 5,976,236). However, for the reasons set forth hereinafter, Applicants respectfully submit that Claims 1, 2 and 4-6 which remain of record in this application, distinguish over the cited references, whether considered separately or in combination.

The present invention is directed to a plasma display panel that is provided with an electrode protective film having superior crystal form and high electrical properties. In particular, according to the invention, and as recited in Claim 1 as amended, "the protective film [is] formed into columnar structures densely packed, closely with each other", with the columnar structures "extending perpendicularly to an interface between the dielectric layer and the protective film". Furthermore, Claim 1 as amended also recites that more than 400 columnar structures are formed per the substrate area of $1\mu m^2$". The plasma

display panel structured with such protective film achieves excellent sputter resistance, and its secondary electron emissions characteristics can also be improved.

An alternating current (AC) plasma display panel (AC-PDP) is a self-emitting flat panel display that uses ultraviolet radiation generated from rare gas discharges. The Ne and Xe gas plasma is induced by the voltage applied between two sustained electrodes, and emits ultraviolet light. Phosphors convert the ultraviolet light to visible red, green and blue light.

In such a display panel, ion bombardment from the Ne and Xe plasma can cause serious damage to the dielectric layer coated on the sustained electrodes, leading in a relatively short time period to a breakdown of stable plasma generation. Thus, the dielectric layer must be coated by an appropriate protective layer made of transparent and anti-sputtering materials. Another important role of the protective layer is to reduce discharge voltages by emitting secondary electrons as a result of Ne^+ ion bombardment. Magnesium oxide (MgO) thin film is the most suitable material for the protective layer in AC-PDP devices because of its compatibility for anti-sputtering and secondary electron emissions.

The secondary electron emission coefficient is easily degraded by surface contamination, such as, for example water and carbon dioxide. In order to attain a less contaminated MgO surface, the crystallinity must be improved to the

greatest extend possible. For this reason, from the viewpoint of increasing the secondary electron emission coefficient, the present invention improves the crystallinity of the MgO protective film using plasma excitation. In a vacuum deposition of thin films, the crystallinity could be improved by enhancing surface migration at the growth.

Claims 1 through 6 have been rejected over the Aoki et al and Yoshihara et al references. The Aoki et al reference, however, discloses only a common structure of the AC plasma display, and does not teach or suggest a detailed structure of the protective film such as recited in Claim 1.

The Yoshihara et al reference, on the other hand, discloses a magnesium oxide film with particles that are not more than 1μm in diameter, as noted by the Office Action at page 3, referring to Column 8, lines 14-26. However, Yoshihara et al also fails to teach or suggest the subject matter of the present invention as defined in Claim 1. In particular, Yoshihara et al teaches that it is necessary to increase the film density in order to improve its strength, adhesion, protective effect and transparency. (See Column 3, lines 28-39.) Furthermore, the surface area of the magnesium oxide film must be increased in order to increase the secondary electron emission rate γ. Accordingly, the Yoshihara et al patent proposes to increase the surface area of the protective film to improve the secondary electron emission rate γ. The particle diameter is specified as not more than 0.3 μm and preferably not more than 0.1 μm, to eliminate gaps among the particles.

Claims 1 through 6 of the present application are directed to the crystallinity of the magnesium oxide with excellent secondary electron emission efficiency, and are not concerned with improving film strength, adhesion, protective effect and transparency. While the Yoshihara et al reference states that the surface area of magnesium oxide in the protective layer should be increased in order to increase secondary electron emissions, Claims 1 through 6 of the present invention are directed toward decreasing the surface area in order to improve the electron emission rate. That is, according to the invention, it is necessary to make the surface area small in order to improve secondary electron emissions. Based on this concept, the columnar structure of magnesium oxide according to the invention provides the film surface continuously from a substrate surface, and is aligned precisely, without gaps.

NOT CLAIMED

The secondary electron emission characteristics according to the invention are enhanced by optimizing the area density of a columnar structure and tip form, and by forming a protective film into columnar structures densely packed closely with each other in a series of crystal structures through the protective film, as recited in Claim 1. The following table summarizes the differences discussed hereinabove:

item	Present invention	US5,975,236
Surface area	small	large
Film structure unit	Columnar structure	Independent particles
Crystallinity of Film structure unit	Series of crystal continuing from surface of the substrate to the opposite surface	Independent particles

Density of film structure unit	400~500/μm^2	?
gap in the film	No	Yes
film forming method	vacuum deposition process	Partial hydrolysis of sol and gel
film disposition temperature	~250°C	~500°C
Second electron emission coefficient	improved	Not improved

In the AC plasma display panel according to the invention, the secondary electron emission rate γ is substantially enhanced for the following reasons. The (111) preferred orientation was reported to be suitable for secondary electron emission. An EB film with 100 nm thickness had poor columnar structures and poor crystallinity; the AIP films with 100 nm thickness on the other hand had well-identified columnar structures and improved crystallinity with (111) preferred orientation. For an efficient secondary electron emission, electrons must be continuously supplied from the MgO crystals to the vacuum. Electron transport is disturbed by scattering with defects in crystals. High quality MgO film is thus strongly preferred in order to achieve a high secondary electron emission rate γ. The crystallinity of the MgO film was considerably improved by well-defined columnar structures. As a result, the surface area according to the invention is considerably reduced compared with a conventional film. The secondary electron emission rate γ is greatly improved due to the improved crystallinity as well as the (111) preferred orientation.

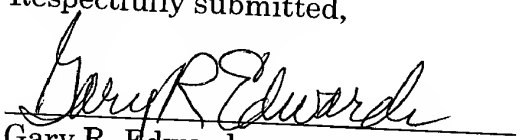
The role of surface area in the MgO protective layer is discussed in Yoshihara et al, which discloses that the surface area of MgO in the protective

layer must be increased, for example from the viewpoint of increasing the secondary electron emission rate in an AC-PDP. On the contrary, according to the present invention, which relies on a different mechanism, the surface area must be made as small as possible, in order to prevent the MgO surface from becoming contaminated. Accordingly, the present invention differs fundamentally from the disclosure in both Aoki et al and Yoshihara et al.

In light of the foregoing remarks, this application should be in condition for allowance, and early passage of this case to issue is respectfully requested. If there are any questions regarding this amendment or the application in general, a telephone call to the undersigned would be appreciated since this should expedite the prosecution of the application for all concerned.

If necessary to effect a timely response, this paper should be considered as a petition for an Extension of Time sufficient to effect a timely response, and please charge any deficiency in fees or credit any overpayments to Deposit Account No. 05-1323 (Docket #381NT/50373).

Respectfully submitted,



Gary R. Edwards
Registration No. 31,824

CROWELL & MORING, LLP
Intellectual Property Group
P.O. Box 14300
Washington, DC 20044-4300
Telephone No.: (202) 624-2500
Facsimile No.: (202) 628-8844
GRE:kms/56208